STATUS REPORT ON NASA RESEARCH GRANT
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"Study of Heat Transfer Through Convective Layers"

by

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During this period quantitative evaluation of the interferograms for the air system has begun and the apparatus for the liquid system has been constructed.

The table below summarizes the ranges in which the experiments have been performed during the present period.

Rayleigh No. Range	Interplate Temp. Range	Plate Spacings
2.6×10^5 to 1.5×10^6	4°C to 12°C	10.917 cm 8.888 cm

All the experiments with the air system have been in the turbulent regime to allow comparison of results with existing theories (e.g., Malkus and Priestley). The interferograms are measured on a toolmakers microscope; the fringe-shift data are then put into a CDC 1604 computer to calculate temperature distribution and heat transfer. A typical temperature distribution curve is shown on the accompanying figure. It shows a steep gradient at the wall and flat profile near the central fluid region. If z is the distance from

one of the horizontal surfaces, the Malkus theory predicts that the temperature in the fluid should vary as z^{-1} when the flow is turbulent. Priestley's mixing length analysis predicts that the temperature difference is proportional to $z^{-1/3}$. Both relations apply to a fluid region not too close to the surface. However, it is found that the temperature distribution measured by us follows neither the z^{-1} nor the $z^{-1/3}$ representation. Additional data must be evaluated to obtain a more precise description of the vertical temperature distribution between the horizontal surfaces.

In regard to heat transfer data, partial evaluation of the experimental data collected shows good agreement with previous investigators using different fluids. The range of results, however, is at this time too limited to permit the determination of an expression which would be valid for a reasonably large range of Rayleigh numbers.

Liquid System for Interferometric Studies

To extend the studies into the regime of larger Rayleigh numbers, liquid media must be used. With this intent, a new system has been designed and constructed which will maintain proper bounding conditions for a liquid layer and simultaneously permit the passage of the interferometer beam. The resulting interferograms will represent temperature distributions incurred in liquid layers.

The essence of the new system is a pair of Muntz metal plates 7" x 10" x 2" thick; each being internally channeled (in the form of a flat double helix) for circulation of water from constant temperature baths to assure the isothermal boundary conditions. Fitting closely about the plates

is a plexiglas aquarium which retains the liquid between the plates; into the ends of this enclosure are mounted 2" thick glass windows through which the interferometric laser beam will pass. The system will be established horizontal within the interferometer with the top plate supported on the bottom plate by glass spacers. Reference pins and thermocopiles will be employed as in the "air" system to give significance to the photographic results.